

Application No. 09/438,266  
Response to Office Action

Customer No. 01933

Listing of Claims:

1. (Currently Amended) A color reproduction system  
comprising:

color image input means for sensing an object;

color estimation means for calculating tristimulus values  
5 from a color image signal obtained by ~~said the~~ color image input  
means; and

color image output means for outputting a color image signal  
based on a color represented by the tristimulus values obtained  
by ~~said the~~ color estimation means,

10 ~~said the~~ color estimation means including:

illumination light measuring means for measuring tristimulus  
values of observation illumination light,

virtual illumination light spectrum calculation means for  
calculating a virtual illumination light spectrum that provides  
15 tristimulus values equal to the tristimulus values of the  
observation illumination light which are obtained by ~~said the~~  
illumination light measuring means, and

tristimulus value calculation means for calculating  
tristimulus values of the object under the virtual illumination  
20 light spectrum from the color image signal.

Application No. 09/438,266  
Response to Office Action

Customer No. 01933

2. (Currently Amended) A system according to claim 1, wherein ~~said~~ the virtual illumination light spectrum calculation means calculates a spectrum from a linear combination of predetermined illumination light spectrum basis functions.

3. (Currently Amended) A system according to claim 1, wherein ~~said~~ the virtual illumination light spectrum calculation means calculates a spectrum satisfying the relation that linear conversion of a product of a spectral sensitivity of ~~said~~ the color image input means and a photographing illumination light spectrum is a product of a color matching function and the virtual illumination light spectrum.

4. (Currently Amended) A system according to claim 1, wherein ~~said~~ the color image input means and ~~said~~ the illumination light measuring means are positioned under different kinds of illumination light.

Claim 5 (Canceled).

Application No. 09/438,266  
Response to Office Action

Customer No. 01933

6. (Currently Amended) A color reproduction system which can sense a predetermined object as a color image, perform color correction of the sensed color image, and perform data transfer through a line, comprising:

5 a color camera for sensing the object under photographing illumination light;

a simplified spectrophotometer for measuring a spectrum of the photographing illumination light;

10 an illumination light colorimeter for measuring tristimulus values of observation illumination light on an object observation side, and transferring the tristimulus value data of the observation illumination light to a color correction device through a line;

15 a color correction device for calculating tristimulus values of the object under the virtual illumination light spectrum generated on the basis of the transferred tristimulus values of the observation illumination light, and converting the tristimulus values into a monitor signal by using monitor profile data; and

20 a monitor for displaying a color image including an object image color-corrected by ~~said~~ the color correction device.

Application No. 09/438,266  
Response to Office Action

Customer No. 01933

7. (Currently Amended) A color reproduction system  
according to claim 6, which can sense a predetermined object as a  
color image, perform color correction of the sensed color image,  
and perform data transfer through a line, comprising:

5        a color camera for sensing the object under photographing  
illumination light;

a simplified spectrophotometer for measuring a spectrum of  
the photographing illumination light;

an illumination light colorimeter for measuring tristimulus  
10   values of observation illumination light on an object observation  
side, and transferring the tristimulus value data of the  
observation illumination light to a color correction device  
through a line;

a color correction device for calculating tristimulus values  
15   of the object under the virtual illumination light spectrum  
generated on the basis of the transferred tristimulus values of  
the observation illumination light, and converting the  
tristimulus values into a monitor signal by using monitor profile  
data; and

20        a monitor for displaying a color image including an object  
image color-corrected by the color correction device;

         wherein said the color correction device comprises:

         a storage device storing a basis function  $\rho$  of a  
daylight spectrum, monitor profile data MTP, color matching

Application No. 09/438,266  
Response to Office Action

Customer No. 01933

25 function data CMF, and spectral sensitivity data  $h$  of ~~said~~ the  
RGB color camera in advance;

a virtual illumination light spectrum calculator for  
calculating virtual illumination light spectrum data  $OS$  from  
tristimulus values  $XYZ$  of observation illumination light  
30 measured by ~~said~~ the illumination light colorimeter and the basis  
function  $\rho$  from ~~said~~ the storage device;

a spectral reflectance calculator for calculating  
spectral reflectance data  $f$  of the object from object  
characteristic data  $\sigma$  and the spectral sensitivity data  $h$  from  
35 ~~said~~ the storage device, RGB image data CRGB input from ~~said~~ the  
RGB color camera, and a photographing illumination light spectrum  
from a simplified spectrophotometer;

a tristimulus value calculator for calculating  
tristimulus value data  $OXYZ$  of the object from the color matching  
40 function data CMF from ~~said~~ the storage device, the virtual  
illumination light spectrum data  $OS$  from ~~said~~ the virtual  
illumination light spectrum calculator, and the spectral  
reflectance data  $f$  from ~~said~~ the spectral reflectance  
calculator; and

45 an output signal calculator for calculating the RGB  
image data CRGB serving as the monitor signal from the monitor  
profile data MTP from ~~said~~ the storage device and the tristimulus  
value data  $OXYZ$  from ~~said~~ the tristimulus value calculator.

Application No. 09/438,266  
Response to Office Action

Customer No. 01933

8. (Currently Amended) A color reproduction system  
according to claim 6, which can sense a predetermined object as a  
color image, perform color correction of the sensed color image,  
and perform data transfer through a line, comprising:

5        a color camera for sensing the object under photographing  
illumination light;

a simplified spectrophotometer for measuring a spectrum of  
the photographing illumination light;

10       an illumination light colorimeter for measuring tristimulus  
values of observation illumination light on an object observation  
side, and transferring the tristimulus value data of the  
observation illumination light to a color correction device  
through a line;

15       a color correction device for calculating tristimulus values  
of the object under the virtual illumination light spectrum  
generated on the basis of the transferred tristimulus values of  
the observation illumination light, and converting the  
tristimulus values into a monitor signal by using monitor profile  
data; and

20       a monitor for displaying a color image including an object  
image color-corrected by the color correction device;

Application No. 09/438,266  
Response to Office Action

Customer No. 01933

wherein ~~said the~~ the color correction device comprises:

a storage device storing the monitor profile data MTP,  
the a color matching function data CMF, and ~~the a~~ a spectral  
25 sensitivity data  $h$  of ~~said the~~ the RGB color camera in advance;

a virtual illumination light spectrum calculator for  
calculating a conversion matrix MTX from the tristimulus values  
IXYZ of the observation illumination light measured by ~~said the~~ the  
illumination light measuring device, the monitor profile data MTP  
30 from ~~said the~~ the storage device, and the color matching function  
data CMF;

a tristimulus value calculator for calculating the  
tristimulus value data OXYZ of the object from the conversion  
matrix MTX from ~~said the~~ the virtual illumination light spectrum  
35 calculator and the RGB image data CRGB input from ~~said the~~ the RGB  
color camera; and

an output signal calculator for calculating RGB image  
data CRGB serving as the monitor signal from the monitor profile  
data MTP from ~~said the~~ the storage device and the tristimulus value  
40 data OXYZ from ~~said the~~ the tristimulus value calculator.

Application No. 09/438,266  
Response to Office Action

Customer No. 01933

9. (Currently Amended) A color reproduction system  
~~according to claim 6, which can sense a predetermined object as a~~  
~~color image, perform color correction of the sensed color image,~~  
~~and perform data transfer through a line, comprising:~~

5        a color camera for sensing the object under photographing  
illumination light;

a simplified spectrophotometer for measuring a spectrum of  
the photographing illumination light;

10       an illumination light colorimeter for measuring tristimulus  
values of observation illumination light on an object observation  
side, and transferring the tristimulus value data of the  
observation illumination light to a color correction device  
through a line;

15       a color correction device for calculating tristimulus values  
of the object under the virtual illumination light spectrum  
generated on the basis of the transferred tristimulus values of  
the observation illumination light, and converting the  
tristimulus values into a monitor signal by using monitor profile  
data; and

20       a monitor for displaying a color image including an object  
image color-corrected by the color correction device;



Application No. 09/438,266  
Response to Office Action

Customer No. 01933

wherein ~~said~~ the color correction device comprises:

a storage device storing object characteristic data  $\sigma$ ,  
monitor profile data MTP, color matching function data CMF,  
25 standard illumination light spectrum data SS, tristimulus values  
JXYZ of standard illumination light, and spectral sensitivity  
data h of ~~said~~ the RGB color camera;

a spectral reflectance calculator for calculating  
spectral reflectance data f of the object from the object  
30 characteristic data  $\sigma$  and spectral sensitivity data h from ~~said~~  
the storage device, RGB image data CRGB input from ~~said~~ the RGB  
color camera, and photographing illumination light spectrum data  
MS from ~~said~~ the simplified spectrophotometer;

a tristimulus value calculator for calculating  
35 tristimulus values SXYZ of the object under standard illumination  
light from the spectral reflectance data f from ~~said~~ the spectral  
reflectance calculator and the color matching function data CMF  
and standard illumination light spectrum data SS from ~~said~~ the  
storage device;

40 a corresponding color calculator for calculating  
tristimulus values CXYZ of a corresponding color of ~~said~~ the  
object from the tristimulus values SXYZ from ~~said~~ the tristimulus  
value calculator, tristimulus values JXYZ of standard  
illumination light from ~~said~~ the storage device, and tristimulus

Application No. 09/438,266  
Response to Office Action

Customer No. 01933

45 values IXYZ of observation illumination light from ~~said~~ the  
illumination light colorimeter; and  
an output signal calculator for calculating RGB image  
data CRGB serving as the monitor signal from the tristimulus  
values CXYZ from ~~said~~ the corresponding color calculator and the  
50 monitor profile data MTP from ~~said~~ the storage device.

Claims 10 and 11 (Canceled).

12. (Currently Amended) A system according to claim 6,  
wherein ~~said~~ the system comprises a plurality of color chips,  
each having a known spectral reflectance, and a digital camera  
having a known spectral sensitivity ~~in place of said illumination~~  
5 ~~light colorimeter~~, and

~~said~~ wherein the color chips are arranged near ~~said~~ the  
monitor and reflected light of observation illumination light  
reflected by each color chip is photographed by ~~said~~ the digital  
camera, thereby calculating tristimulus values of the observation  
10 illumination light from a photographing signal of each color chip  
which is obtained by photographing, spectral sensitivity data of  
~~said~~ the digital camera, spectral reflectance data of each color  
chip, and color matching data.